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CHILD DEVELOPMENT

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DOLL PLAY AS A FUNCTION OF THE DOLL FAMILY CONSTELLATION[1]

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Projective doll play, in recent years, has gained increasing prominence as a diagnostic and therapeutic measure for dealing with children's adjustment difficulties. Through the medium of dolls the child may express his attitudes toward his world and the people in it, his fears and anxieties, his affection and aggression, his needs and motives. In the relatively "objective" play situation he may reveal and work through the problems, effecting catharsis and insight.

Much of the literature on projective play has presented interpretive rather than methodological studies, reviewing individual case histories instead of experimental data. Various materials and methods have been used, each therapist determining the extent of his participation in the situation and the structure and relative freedom of the play. The child's identification with the dolls, in some cases, has been forced and, in others, has been allowed to appear spontaneously.

Investigation of the quality and content of young children's fantasy behavior in doll play as a function of certain demonstrable variables has been the general purpose of a series of studies in projective play done at the Iowa Child Welfare Research Station (1, 9, 10, 11, 12, 14). A methodological approach to the problems of identification and aggression has been attempted in the present study (12). The relationship of behavioral signs of a child's identification with the dolls to other factors in the play situation has not previously been discussed to any extent by psychiatrists or experimenters.

Conn (3) and Solomon (13) centered the child's play around his specific problems by creating a situation with dolls representing the actual characters involved. Although the doll which stands for the child is the most important one, Solomon felt that identification should not be forced, and recommended that the child not be made to feel that the play refers to himself. In Levy's (7) experimental studies of sibling rivalry, in which the child was presented with a mother doll, a baby doll, and a doll representing himself, identification with the self doll was inferred.

[1] *This is the fifth in a series of studies of projective doll play performed at the Iowa Child Welfare Research Station under the direction of Dr. Robert R. Sears.*

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Despert (4), in examining the personality reactions of preschool children, gave her subjects four dolls, a man, a woman, a baby, and a boy or girl, according to the sex of the particular child. She found that each child identified in some manner with the dolls and that aggression, the most striking aspect of the play, was often directed at members of the family whom he identified.

Investigating doll play as an aid to understanding and guiding the normal preschool child, Baruch (2) offered dolls duplicating the subject's family constellation. The child was helped by the examiner to identify the dolls with his own family if he did not do so of his own accord.

Bach (1) introduced a miniature preschool set with a teacher doll and three child-dolls, one of which was an "identification doll" with which the child was urged to identify. It was found that stimulation to identification, if pressed too far with certain children, was met with resistance.

The present study had as its purpose, generally, to determine the effects of using in a projective play situation dolls which represented the child's own family constellation, as compared with a standard set of dolls; and, specifically, to examine the extent, kind, and direction of aggression, the amount and type of thematic play, and the frequency of identification under these experimental conditions.

Method

Experimental Variables

Two variables were considered in this study: 1) the type of doll family, as to whether it did or did not duplicate the child's own family, and 2) the presence or absence of siblings in the child's own family. The 50 children used as subjects were divided into four groups as follows:

I. No sibling, dolls duplicate own family
II. One sibling, dolls duplicate own family
III. No sibling, standard doll family
IV. One sibling, standard doll family

Groups I and II, which together may be called the Duplicated Family group (DF), received a set of dolls designed to represent the immediate family constellation of each subject, i.e., the people residing in his home. Only dolls that represented parents, siblings, and relatives were presented; roomers and student help were not included. If the subject's father was away from home, no father doll was offered. If he was at home, but in the armed service, the doll was dressed in the appropriate uniform. Sibling dolls were identifiable as to sex and age in

relation to those of the doll representing the child, i.e., the size of these dolls varied to indicate a difference in ages. Instructions, dependent upon the subject's family constellation, were worded to induce identification with the dolls.

Groups III and IV, together called the Standard Family group (SF), were presented with a standard set of five dolls which did not represent the subject's own family. It included a civilian father, a mother, a boy and a girl of the same size, and a baby. Standard instructions were given.

The organized house furnishings (Figure 1) were the same for both groups with one exception; in the DF group, the crib and high chair were removed if there was no baby in the subject's family.

Figure 1. Experimental materials: standard family dolls at the right, additional dolls for duplicated family at the left.

Subjects

The subjects were 50 children from the Preschool Laboratories of the Iowa Child Welfare Research Station in Iowa City, and from the Crocker School, the Jewish Community Center,

and the Salvation Army Center in Des Moines. Thirty-five children were from the Preschool Laboratories, and 15 from the Des Moines schools.

The DF and SF groups were equated for 1) age, 2) sex, 3) the number, relative age, and sex of siblings, 4) the father's being at home or away from home, i.e., in the armed service or traveling for business, 5) extra members of the household, e.g., relatives, roomers, student help, and 6) amount of previous experience in doll play procedures. Matching with regard to family constellation was made on the basis of the family group as it existed during the month preceding the experimental sessions.

Each group was composed of 13 boys and 12 girls. There were 18 children with no sibling and 32 with one sibling, these being distributed equally in the DF and SF groups.

The chronological age range of the total group of subjects was from 3-2 to 6-2, with a mean age of 4.6 years. The mean chronological ages of the children in the four subgroups varied from 4.5 to 4.7 years.

The amount of each child's previous experience with doll play procedure in the Phillips (9), Pintler (10), and Yarrow (14) experiments was considered in matching the subjects. The children who were without previous experience were given preliminary sessions by another examiner at least a month before the experimental sessions in order to familiarize them with the situation. The amount of former experience for all children ranged from 40 to 80 minutes.

Experimental Materials

The experimental materials consisted of 10 clothed, life-like dolls, a set of realistic doll furniture, and 15 composition wall pieces. The wooden furniture, specially constructed for the experimental work, was made to the scale of one inch to a foot and was proportional to the size of the dolls used. Presented in an organized form, the house was 32 inches long and 25 inches wide. The furniture for the kitchen consisted of a sink, a refrigerator, a stove, a table, three chairs, and a high chair; for the dining room, a round table and four chairs with blue cloth-covered seats; for the living room, a radio, a small table, a davenport and three easy chairs, upholstered in red, green, and blue; for the parents' bedroom, a double bed, a crib, and a dressing table and chair; for the children's bedroom, two single beds and a dresser; and for the bathroom, a toilet, a tub, and a washbowl. The walls with small wooden bases were made of sturdy composition material. The height was three and one-fourth inches, and the lengths varied, six, nine, and sixteen

inches.

None of the pieces was stationary, so there was great opportunity for rearrangement and organization. In order to reduce as much as possible the subject's exploratory behavior, the furniture possessed no manipulative parts; for example, the faucets would not turn, the toilet seat and cover were nailed in place, the refrigerator door would not open, and there were no removable drawers.

The dolls were made of string wrapped around a pipe cleaner base and were dressed in unremovable, colorful cotton clothes. The hair was composed of woolen yarn, and the shoes, painted brown, were molded from papier maché. Three adult male dolls, dressed in Army, Navy, and civilian suits, measured six inches in height; two adult female dolls, five and one-half inches; two sets of boy and girl dolls, three and one-half and two and one-half inches; and a baby doll, one and one-half inches. Clothes and hair of different colors differentiated dolls of the same sex and size. Light and flexible, the dolls were easy for the child to handle and could be placed in a sitting or standing position.

Procedure

Two experimental sessions, each a half-hour in length, were presented approximately 48 hours apart under conditions of Pintler's (10) high experimenter interaction. Such interaction consisted of 15 to 20 verbal contacts with the child every five minutes; these were limited to establishment of rapport, stimulation to stay in the experimental situation, and general stimulation to thematic elaboration.

As the child was brought to the experimental room, the experimenter carried on a friendly conversation with him and attempted to provoke a pleasant anticipation of the toys. Upon entering the room the child was shown the materials. The instructions given varied for the DF and SF groups. To the children of the SF group the experimenter said, "Here is a family of dolls and the house that they live in. You may play with them any way you like." Instructions for the DF group were altered to fit the family constellation of each subject; e.g., "Here is a family of dolls and the house that they live in. See, here is the mother, the little girl, and her baby brother. Daddy is away in the Army. You may play with them any way you like."

After introducing the materials, the experimenter, seated on the floor near the child, immediately started to record the child's behavior and the experimenter-child interactions. Throughout the sessions the experimenter maintained a friendly interest in and a non-evaluative attitude toward the child's ac-

tivities.

The child's behavior was recorded in 15-second samples by use of a notational system adapted to a great extent from that used by Phillips (9) and Pintler (10). An automatic timing device buzzed every 15 seconds to mark the time. For the majority of the categories, judgments were made during the interval but were recorded at the end of it, when the buzzer sounded the termination of the interval. The remainder, including instances of aggression, identification, inappropriate action, metamorphosis, and experimenter-child interaction, were recorded at the instant they occurred.

Questions sometimes arose regarding the experimenter's recordings and the buzz of the timing device. In response to curiosity concerning the sound, the experimenter explained that it was a clock in another room which kept time by buzzing every 15 seconds. If the child inquired about the recordings, the experimenter replied that it was just a way of keeping track of the dolls and the furniture and directed his attention back to the materials. Throughout the sessions an attempt was made to keep the child from realizing that there was any relationship between his activity and the recordings.

Categories and Scoring

Categories were designed to describe the behavior of the child and were recorded in terms of their corresponding symbols.[2] Several of the categories are essentially the same as those discussed by Phillips (9); E, exploratory; O, organizational behavior; T, tangential activity; P, tangential play; and Th, routine (stereotyped) thematic play. In addition, the following categories were used:

ITh - Individualized thematic play
Any thematic action or verbalization, with or without dolls, indicating a situation which is not defined under routine thematic play or in which the materials are not used according to their given purpose, e.g., warfare, earthquake, train or airplane rides, and school or hospital scenes (involving metamorphosis).

M - Metamorphosis Cf. Bach (1)
A change in role or meaning of the dolls or equipment. For example, the bathtub may become an automobile; the home, a school; the father doll, a bomb.

x - Inappropriate action
Nonaggressive action or organization of materials which is inappropriate to the ongoing theme, e.g., washing dishes in the living room, or the father's sleeping in the baby's crib.

[2] *For a detailed description of categories and scoring procedure see Robinson (12).*

i - Identification

Activity or verbalization in which the child relates himself or his family to a theme or the experimental materials. This may include the use of the pronoun "I" with reference to a doll, thematic action, or experience; calling a doll by his own name; identifying dolls with members of his own family; relating thematic action to his own or family experiences; assuming a role and acting thematically himself, as indicated by a statement to this effect; and favoring or showing emotional concern about a particular doll.

Aggression

Hostility as expressed in action or implied through tone of voice and content of speech. Interpretations are in accordance with the definition by Dollard, Doob, Miller, Mowrer, and Sears (5): "Any act whose goal response is injury to an organism (or organism-surrogate)." Hostility may be directed from the subject to the dolls, to the other experimental materials, or to the experimenter, or from the dolls to each other or to the equipment.

Two kinds of aggression have been considered, stereotyped and nonstereotyped.

Stereotyped aggression

Any form of aggressive behavior which may actually occur in the average, middle-class home situation; assertive actions or verbalizations which are appropriate to time, place, character, and capability of the agent of aggression.

Nonstereotyped aggression

Any form of aggressive behavior, distinguished from stereotyped aggression by its intensity, inappropriateness, or individualistic quality, which would not be expected in average home relationships.

Examples of stereotyped and nonstereotyped aggression in doll play are listed in Table 1.

Location of thematic play

The following symbols were used to indicate the location of thematic play:

K Kitchen	Bp Parents' Bedroom
D Dining Room	Ba Bathroom
L Living Room	O Outside the house
B Children's Bedroom	

Recording of behavior

Behavior was recorded on mimeographed score sheets, composed of four rows of twenty 15-second interval spaces on a side, each row being subdivided for notations of the location of thematic play, general behavior categories, and instances of aggression. Six kinds of notations were used.

1. Each change in the location of thematic play was indicated by the appropriate symbol in the location line.
2. The corresponding symbol was recorded in the behavior line for action characteristic of the general behavior categories (E, O, Th, ITh, T, P) which continued longer than one-half of a 15-second interval.
3. The symbol for metamorphosis was recorded once above the location of theme line at its first occurrence.
4. Instances of identification and inappropriate action or organization were noted in the general behavior line once per 15-second interval in each interval in which they occurred. If they occurred twice in one interval, only one symbol was recorded.
5. Instances of aggression were recorded in the aggression line as they occurred, the agent, object, and kind of aggression being noted.
6. Experimenter-child interactions were tallied below the aggression line.

TABLE 1

EXAMPLES OF AGGRESSIVE BEHAVIOR IN DOLL PLAY

STEREOTYPED AGGRESSION	NONSTEREOTYPED AGGRESSION
I. General	I. General
1. Arguing, quarreling	1. Hitting or beating, vigorously and injuriously
2. Commanding (in aggressive tone)	2. Kicking, knocking down
3. Scolding	3. Jumping on, crushing, breaking
4. Threatening	4. Throwing out window
5. Criticism of behavior	5. Stuffing into and under furniture, including stove, sink, toilet
6. Depreciation of person	6. Doll assuming role of witch, giant, animal, inanimate object with destructive consequences
7. Attribution of bad qualities	7. Trapping
8. Swearing	8. Killing
9. Teasing	9. Any hostile or destructive acts of which the child would be incapable in real life
II. Parent to child (dolls)	II. Parent to child (dolls)
1. Any of the general examples	1. General examples
2. Sending to bed	2. Hitting
3. Sending away from table	3. Hiding from children
4. Isolation	III. Parent to parent
5. Deprivation	1. General examples
6. Spanking or slapping	2. Physical fighting, e.g., hitting, kicking, spanking
7. Refusal of requests	IV. Child to parent
8. Restriction or prohibition of activity	1. General examples
9. Forcibly taking away objects	2. Spanking
III. Parent to parent	
1. General examples	
IV. Child to parent	
1. General categories	
2. Refusal to comply with requests	

Examples of Aggressive Behavior in Doll Play

STEREOTYPED AGGRESSION	NONSTEREOTYPED AGGRESSION
3. Riding	V. Child to child
4. Running away	1. General examples
5. Crying	VI. Subject to dolls or equipment
V. Child to child	1. Spanking, hitting, slapping with intensity or strong emotional involvement
1. General examples	2. Stepping on or breaking dolls or furniture
2. Fighting	3. Having dolls trip or fall off or over furniture
3. Hitting	4. Having a character die
4. Kicking	5. Banging or pushing over doll furniture or walls
VI. Subject to dolls or equipment	6. Having a storm blow down the house or furniture
1. General categories	7. Child assuming the role of a destructive agent
2. Spanking, hitting, or slapping the dolls	

Aggression was recorded by notation of agent, object, and kind (stereotyped or nonstereotyped). Symbols used to indicate agent and object of aggression were:

Agent

- b Baby doll
- c The subject
- d The doll which represents the subject; the "self doll." In the SF group, d is the child doll of the same sex as the subject
- f Father doll
- gf Grandfather doll
- gm Grandmother doll
- l Fantastic agent, something not human but which may appear animate or dynamic to the child, e.g., witch, fairy, animal, storm. Also, a person outside the family constellation
- m Mother doll

q Other experimental materials, i.e., furniture, walls
s Sibling doll, other than the baby
fam Two or more dolls of the family group

Object

The above symbols were also used to designate the object of aggression. In addition, the symbol x denoted aggression toward the experimenter.

A combination of symbols was recorded at each instance of aggression, e.g., aggression from the mother to the baby was recorded as mb, or from the subject to the furniture as cq. When the source of aggression was not indicated by definite action or verbalization, the subject was considered as the agent. Because of the predominance of nonstereotyped aggression, no additional symbol was used to qualify it. If the aggression was stereotyped, an S was placed to the right of the direction symbols, i.e., fdS. Each instance of aggression was recorded in a 15-second frame of reference, and statistical analysis was made in terms of the total number of instances during the sessions.

Reliability

Reliability of the scoring method was determined by simultaneous observation with another observer (Yarrow) during 295 minutes of doll play carried out under the conditions described for the SF group. One observer served as experimenter in the room with the child, while the other observed the activity from an observation chamber fitted with a one-way screen.

The statistical procedure used was that of percentage of agreement between observers. Percentages of agreement on the general behavior categories, totaled and separate, and instances of identification, inappropriate action, metamorphosis, and occurrence of aggression, were computed by the formula:

$$\frac{\text{2 times the total number of agreements of observers A and B}}{\text{the total number of observations of A plus B}}$$

Percentage of agreement on direction, agent, object, and kind of aggression were determined by the formula:

$$\frac{\text{2 times the number of agreements of A and B on the item}}{\text{the total number of agreements of A and B on the occurrence of aggression}}$$

The criteria for agreement were:

1. For the general behavior categories (E, O, T, P, Th, and ITh): the same symbol recorded in the same 15-second interval by each observer.
2. For all other categories, except identification: the same item of behavior recorded within two adjacent 15-second intervals by each observer. Here, the interest lay in the

frequency rather than the sequence of occurrence. Reliability for identification was determined within a one-minute frame of reference.

The criteria for disagreement were:

1. Omission of an item of behavior by one of the observers.
2. Failure to record items of behavior according to the criteria for agreement.

The percentages of agreement are presented in Table 2. It is interesting to note that, despite the low percentages of agreement on tangential and tangential play, there was never any disagreement between these two categories.

Results

Mean Frequencies of Behavior

The mean frequency of each category of behavior during the two 30-minute sessions of doll play under four combinations of experimental variables is presented in Table 3. The No Sibling groups contained 9 subjects; and the One Sibling groups, 16 subjects. No outstanding differences among the variables were noted, except in the case of identification, of which there was a greater amount in the DF groups. There was also more organizational behavior and less routine thematic play in the DF-No Sibling group.

A distinction was made between thematic and nonthematic aggression. Instances of aggression which occurred in conjunction with routine or individualized thematic play were designated as thematic; those occurring with exploratory, organizational, tangential activity, or tangential play, as nonthematic.

It is interesting to note the wide discrepancy between certain behavior categories under all experimental conditions. There was predominantly more organizational than exploratory behavior, more thematic than tangential activity, more routine than individualized thematic play, and more tangential activity than tangential play. Thematic aggression exceeded nonthematic aggression; and, in contrast to the results found with regard to thematic play, individualized thematic aggression was greater than routine thematic aggression. Nonstereotyped aggression was strikingly more frequent than stereotyped aggression.

No statistical analysis was made of location of thematic play or of direction of nonthematic aggression.

TABLE 2

FREQUENCY OF OCCURRENCE AND PERCENTAGES OF AGREEMENT BETWEEN TWO OBSERVERS' RECORDINGS OF THE VARIOUS CATEGORIES DURING 295 MINUTES OF OBSERVATION FOR RELIABILITY OF THE SCORING METHOD

Category	Frequency	Percentage of agreement
Total general behavior categories (E, O, T. P, Th, ITh)	2366	89.0
Exploratory	259	81.8
Organizational	427	87.6
Tangential	52	65.4
Tangential play	33	54.5
Routine thematic play	1307	93.2
Individualized thematic play	281	89.7
Metamorphosis	15	80.0
Inappropriate action	110	80.0
Identification	19	84.2
Aggression		
Occurrence	500	78.8
Direction	*394	79.2
Agent	*394	87.8
Object	*394	82.2
Nonstereotyped	336	85.9

*Percentage of agreement was based upon the total number of agreements on the occurrence of aggression mentioned by each observed.

Differences Between Mean Frequencies of Behavior

Table 4 shows the reliabilities of the differences in mean frequencies of behavior between the DF and SF groups and the No Sibling and One Sibling groups. The scores of the children in the DF group were compared with those in the SF group, and those in the No Sibling group with those in the One Sibling group. Each group was studied as a whole. Although the subjects were selectively distributed among the experimental groups on the basis of several criteria and were thus possibly more closely related than would be children drawn entirely at random, they were not matched individually in each group. Therefore, Lindquist's formula for the significance ratio (t) of the difference between the means of independent random samples was used (8,

TABLE 3

MEAN FREQUENCIES OF BEHAVIOR DURING TWO THIRTY-MINUTE SESSIONS OF DOLL PLAY UNDER FOUR COMBINATIONS OF EXPERIMENTAL VARIABLES

Category of Behavior	DF-No Sibling N = 9	DF-One Sibling N = 16	SF-No Sibling N = 9	SF-One Sibling N = 16
Exploratory	20.4	20.1	19.9	27.3
Organizational	71.6	46.7	49.8	47.8
Tangential	21.6	24.6	35.4	29.3
Tangential play	13.9	14.6	11.4	17.2
Routine thematic play	76.1	92.4	89.1	87.3
Individualized thematic play	36.4	41.6	34.3	31.0
Metamorphosis	1.8	2.2	2.3	1.1
Inappropriate action	9.2	6.5	6.7	8.3
Identification	7.6	5.9	3.1	1.7
Total aggression	43.2	48.1	37.1	43.1
Nonthematic aggression	13.9	13.4	11.4	14.2
Thematic aggression	29.3	34.6	25.7	28.8
Routine thematic aggression	10.0	8.0	8.9	10.1
Individualized thematic aggression	19.3	26.6	16.8	18.8
Stereotyped aggression	2.6	3.0	4.0	3.3
Nonstereotyped aggression	40.7	45.1	33.1	39.8

p. 138). Results in the table are given in terms of the difference between the means and the level of confidence (1 of c) for this difference.

With the DF condition, identification was significantly greater, at better than the one percent level of confidence, than with the SF condition. There was a slight tendency (at the 20 percent level) toward more exploratory behavior in the SF than in the DF group, and more organization of materials in the No Sibling than in the One Sibling group.

Direction of Thematic Aggression

Instances of thematic and nonthematic aggression were classified according to agent and object. Each experimental group differed in its combination of variables, and, therefore, no consistent pattern of dolls was presented to all the subjects. The categories of direction which each group had in comn.on, how-

TABLE 4

SIGNIFICANCE OF THE DIFFERENCES IN MEAN FREQUENCIES OF BEHAVIOR BETWEEN THE DUPLICATED FAMILY AND STANDARD FAMILY GROUPS AND THE NO SIBLING AND ONE SIBLING GROUPS (N = 50)

Category	Duplicated Family Standard Family		No Sibling-One Sibling	
	Mean Diff.	l of c	Mean Diff.	l of c
Exploratory	*4.4	20	*3.5	30
Organizational	7.1	50	13.5	20
Tangential	*8.0	40	1.6	90
Tangential play	*0.8	90	*3.2	60
Routine thematic play	*1.5	—	*7.2	70
Individualized thematic play	7.6	40	*0.9	--
Metamorphosis	0.4	70	0.4	70
Inappropriate action	*0.2	—	0.5	80
Identification	4.3	1	1.5	40
Total aggression	5.4	60	*5.4	60
Nonthematic aggression	0.4	—	*1.1	90
Thematic aggression	5.0	50	*4.2	60
Routine thematic aggression	*0.9	70	0.4	90
Individualized thematic aggression	6.0	40	*4.6	50
Stereotyped aggression	*0.8	50	0.1	—
Nonstereotyped aggression	6.1	70	*5.5	60

* Greater frequency in the second-mentioned variable.

ever, were the subject himself, the "self doll," the mother doll, a family group of two or more dolls, a fantastic agent, the experimental materials, and the experimenter.

Table 5 presents the mean frequencies of agents and objects of thematic aggression under each combination of variables. There was somewhat more aggression emanating from the mother doll, sibling doll (other than baby), and fantastic agent under the DF than under the SF condition. Aggression toward the mother doll was greater with the DF condition. The self doll and father doll, as well as the grandmother doll, were the objects of more aggression in the DF-No Sibling group than in any other group. In the DF-One Sibling group the experimental materials, the sibling doll, the family, and particularly the baby doll, received more aggression than in other groups.

Differences in Direction of Thematic Aggression

Further analysis of thematic aggression was made for sev-

TABLE 5

MEAN FREQUENCIES OF AGENTS AND OBJECTS OF THEMATIC AGGRESSION DURING TWO THIRTY-MINUTE SESSIONS OF DOLL PLAY UNDER FOUR COMBINATIONS OF EXPERIMENTAL VARIABLES

	Category	DF-No Sibling	DF-One Sibling	SF-No Sibling	SF-One Sibling
Agent of aggression					
b	Baby doll	—	0.7 (3)[1]	0.1	0.6
*c	The subject	21.0	24.3	21.1	20.7
*d	Self doll	1.2	1.4	1.2	0.9
f	Father doll	2.5 (6)	2.1 (10)	1.2	2.8
gf	Grandfather doll	—	0.0 (1)	—	—
gm	Grandmother doll	0.0 (1)	0.5 (2)	—	—
*l	Fantastic agent	3.2	3.2	0.7	2.0
*m	Mother doll	2.1	1.7	0.7	1.1
*q	Experimental materials	0.1	0.1	0.0	0.1
s	Sibling doll	—	1.5 (13)	0.4	0.1
*fam	Family (two or more dolls)	0.0	1.2	0.2	0.4
Object of aggression					
b	Baby doll	—	11.0 (3)	4.8	4.2
*c	The subject	0.2	0.0	0.0	0.2
*d	Self doll	8.1	3.5	3.4	3.2
f	Father doll	7.0 (6)	4.6 (10)	4.2	5.4
gf	Grandfather doll	—	0.0 (1)	—	—
gm	Grandmother doll	3.0 (1)	1.5 (2)	—	—
*l	Fantastic agent	0.2	0.4	0.1	0.6
*m	Mother doll	7.4	7.0	3.4	3.7
*q	Experimental materials	5.8	8.6	3.8	5.6
s	Sibling doll	—	5.8 (13)	2.2	1.9
*x	Experimenter	0.0	0.1	0.2	0.3
*fam	Family (two or more dolls)	2.6	5.2	3.4	3.7

* Categories that all groups had in common.

1. The numbers in parentheses indicate the number of children who were presented with these dolls; mean frequencies were based upon these cases.

eral categories which were comparable for each experimental group. Significance of the differences in mean frequencies of thematic aggression between the DF and SF and the No Sibling and One Sibling groups, shown in Table 6, was computed for the agents (the subject, self doll, and mother doll) and objects of aggression (self doll, mother doll, and experimental materials).

TABLE 6

SIGNIFICANCE OF THE DIFFERENCES IN MEAN FREQUENCIES IN DIRECTION OF THEMATIC AGGRESSION BETWEEN THE DUPLICATED FAMILY AND STANDARD FAMILY GROUPS AND THE NO SIBLING AND ONE SIBLING GROUPS (N = 50)

Category	Duplicated Family–Standard Family		No Sibling–One Sibling	
	Mean Diff.	1 of c	Mean Diff.	1 of c
Agent of aggression				
c The subject	2.3	70	*1.4	80
d "Self doll"	0.4	60	0.0	—
m Mother doll	0.9	30	0.0	—
Object of aggression				
d "Self doll"	1.9	20	2.4	10
m Mother doll	3.6	5	0.1	—
q Experimental materials	2.6	40	*2.3	40

* Greater frequency in the second-mentioned variable.

No significant differences appeared with regard to the agent of aggression. As an object of aggression, the self doll received somewhat reliably more aggression (10 percent 1 of c) in the No Sibling group than in the One Sibling group, and there was a tendency for this to happen also in the DF group. Greater aggression toward the mother doll in the DF group was relatively significant at the 5 percent level.

Comparison of Identifying and Non-identifying Children

Children who manifested instances of identification were compared with those who did not with regard to individualized thematic play, total thematic aggression, individualized thematic aggression, and nonstereotyped aggression. Thirty-seven children, 17 boys and 20 girls, showed some form of identification. All but three of the 25 children in the DF group identified, while in the SF group, 10 children failed to do so. Five of the 18 children with no sibling and 8 of the 32 children with one sibling did not identify.

Identifiers showed a slight tendency (20 to 30 percent 1 of c) to exhibit more individualized thematic play than non-identifiers,

but no significant trend was observed for total thematic, individualized thematic, and nonstereotyped aggression. A correlation ratio of -.50 (standard error ±.16) between identification and total thematic aggression was obtained (6).

Discussion

The variables under consideration in this study appeared not to influence significantly the general behavior categories, with the exception of identification, and did not produce results outstandingly different from those of the previous doll play research in this series.

It has been assumed that identification is inherent in projective doll play. The significance of the extent and manner in which overt signs of identification vary with certain experimental conditions and correlate with other measures of observable behavior may be of interest in determining its importance in the clinical situation.

Children in the DF group were presented with dolls which duplicated their own family constellations and were given instructions designed to induce identification. Instances of identification were shown to be significantly greater (better than the one percent level of confidence) in this group than under the SF condition.

With such a large difference in identification between the DF and SF groups one might expect to find a corresponding difference in the type and amount of thematic play or aggression exhibited. But this does not seem to be the case; routine and individualized thematic play, as well as aggression, did not vary significantly with these variables.

An analysis of the changes in thematic aggression which may be predicted from changes in identification was made for the 37 children who showed identification. Instances of identification ranged from one to 19 and those of aggression, from one to 96. A slight, negative, curvilinear relationship between the identification and aggression of these children was indicated by the correlation ratio (-.50; standard error ±.16). There was a slight tendency for thematic aggression to decrease as identification increased. This relationship, however, did not hold for all cases. Low thematic aggression was generally associated with high identification and the relationship was moderate near the mean of the distribution, but low identification did not always result in high aggression. Children who had from one to three instances of identification gave from one to 96 instances of thematic aggression. The scatter of aggression scores was more limited at the high identification portion of the scale. An

arbitrary division of thematic aggression and identification scores and their corresponding case frequencies may illustrate this relationship.

Identification	Aggression			
	1-22	23-44	45-66	66-96
1-3	5	5	3	4
4-12	7	8		
13-19	5			

Bach (1) found that, with regard to the fantasy behavior of a group of seven children who identified with his "identification-doll," as compared with an equal number of non-identifiers, the latter group showed significantly fewer "nasty" fantasies, less associated aggression, and were less emotionally involved in play. He suggested that

> . . . when the child is made consciously aware of the identification through "identification-stimulation" he tends to reject this behavior and . . . it then becomes associated with failure to lose inhibitions. . . . It is plausible that even spontaneously occurring identification, when recognized by S, would lead to inhibition on the theory that conscious identification increases the similarity between real social situations and fantasy doll situations; this would facilitate generalization of inhibition from social experiences to thematic play behavior. (1, p. 49.)

In the present study, specific identification with the self doll was not pressed. An indirect suggestion was made that the doll family was the same as that of the subject, and any identification was allowed to appear spontaneously. The criteria of identification were not as centered around the identification-doll as were those of Bach, but were enlarged to include identification with the family. Therefore, identification could be of the home-and family-comparison kind as well as of the "I," "self-thematic," and role-taking kinds. The method of recording did not differentiate these types or indicate with whom or what the child identified.

Since the identification-stimulation was less intensive than that applied by Bach, and since the children were not under any compulsion to identify with the self doll or doll family, we should not expect to find the associated tendency to reject identification or for them to be greatly inhibited in their activity, even though aware of the resemblance to some extent. This may

account for the somewhat more individualized thematic play of the children who displayed identification in some way. Although total thematic aggression and nonstereotyped aggression did not differ significantly between identifiers and non-identifiers, the slight tendency for aggression to decrease within the identifying group as identification increased would be in line with Bach's theory. The wide variability of scores among the subjects, however, must be considered in this respect.

There was a general impression that the instances of identification in the DF and SF groups were of the same nature. References to personality or non-doll similarities and experiences at home in relation to the experimental materials or thematic play were on a more conscious, superficial, conversational level than on that of a deep anxiety-provoking quality of identification. Perhaps there is less anxiety when the child is able to use a whole family with which to identify than if urged to identify with one doll. Then again, in these presumably normal preschool children, anxiety may not have been a factor leading one way or another to identification, thematic play, or aggression. We have no way of determining the completeness of the identification; from a few instances we may not imply a total acceptance of "That's my family." The occurrence of identification was also inconsistent; it varied from one kind to another and was not always apparently present.

Although the amount and kind of aggression did not differ reliably with the experimental variables, the direction of thematic aggression showed interesting differences. No significant differences were observed between groups with regard to the agent of aggression. This research was conducted during the war and, in some cases, a child's father was in the service away from home, a fact which is noticeable under the DF condition. In the DF-No Sibling group, six children received the father doll and one child, a grandmother doll. In the DF-One Sibling group a baby doll was presented to the child whose sibling was under 18 months old. The size of the sibling doll varied in relation to the age of the child and that of his brother or sister. In this group three children were given the baby doll; 13 children, a sibling doll; 10 children, the father doll; two children, the grandmother doll; and one child, the grandfather doll. The groups, therefore, were not comparable as a whole, but were in part, all having available the self doll, fantastic agent, mother doll, family group, experimental materials, and the experimenter.

Reliable differences for object of aggression were found for the mother and self dolls. The significant predominance of aggression toward the self doll in the No Sibling group may be a

function of the small number of dolls presented to these children. There was a similar tendency for aggression toward the self doll to be greater in the DF than in the SF group. Levy (7) describes aggression toward the self doll as a form of "self-punishment or self-retaliatory hostility," which appeared as severe or as mild as the preceding hostility toward other dolls. The role of the self doll is not clear; few children in the present study consciously stated an identification with it.

In the DF groups there seemed to be a more selective concentration of aggression than in the SF groups. Significantly more aggression under the DF condition was directed toward the mother doll; the father doll in the DF-No Sibling group received large amounts of aggression. In the DF-One Sibling group it is interesting to note that the baby doll was the object of more aggression than was the doll representing an older sibling. Aggression in the SF groups was more evenly distributed among the categories than in the DF groups. Greater aggression in the DF group (particularly the DF-No Sibling group) toward the self doll, if a result of this localization of aggression, would support Levy's observation.

These results would suggest that, although presenting a set of dolls duplicating a child's family produces reliably no more difference in amount or kind of aggression than does a standard set of dolls, the way in which this aggression is distributed and directed under the DF condition may be of diagnostic significance in indicating areas of tension in the home situation. One would expect this to be more revealing in the case of individual children and in a clinical frame of reference.

In interpreting these results, however, the inequality of the groups of subjects and the number of dolls which they received must be taken into account, as well as the mixture of variables and the variability of aggression and identification scores. The children under the DF condition received an average of 3.4 dolls with which to play, while those under the SF condition were given five dolls. The DF-No Sibling group had an average of 2.8 dolls and the DF-One Sibling group, 3.8 dolls. Different numbers of children played with each doll. If relatively the same amount of aggression was shown by each group, that with fewer dolls would receive a larger proportion of aggression for each doll. A control experiment, in which the DF and SF groups contain children whose families are of the same size and in which the dolls are comparable for all groups, would throw light upon this question. A more generalized distribution of aggression in the SF group in relation to the amount of aggression toward the self doll and others in the DF group may, again, indicate the value of a duplication of family constellation

in doll play.

Conclusions

1. Under the DF condition, the frequency of identification signs was significantly higher at better than the one percent level of confidence than with the SF condition.
2. No significant differences in mean frequencies of the general behavior categories were found between the No Sibling and One Sibling groups or, with the exception of identification, between the DF and SF groups.
3. As an object of aggression, the self doll received significantly more thematic aggression in the No Sibling group than in the One Sibling group, and there was a similar tendency in the DF group. There was reliably greater thematic aggression toward the mother doll in the DF than in the SF group.
4. No reliable differences between groups appeared with regard to the agent of aggression.
5. A correlation ratio of -.50 (standard error $\pm$.16) between identification and thematic aggression was obtained. There was a large variability in scores.
6. No significant differences in amount and kind of aggression were found between children who showed identification and those who did not.
7. There appeared to be a more selective concentration of aggression in the DF than in the SF groups, suggesting a diagnostic value in the use of a duplicated family constellation.
8. The inequality of groups of subjects and the number of dolls which they received, the mixture of variables, and the variability of scores must be considered in the interpretation of these results.

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SEXUAL MATURATION AND THE GROWTH OF FAT, MUSCLE AND BONE IN GIRLS

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In a previous paper (1), a method was described for comparing children in terms of the breadths of bone, muscle mass and superficial fat in the leg. Measurements of these three tissue components in this anatomical area were based on a longitudinal series of roentgenograms, taken specifically for the study of tissue differentiation. Growth changes, sex differences and individual variations in tissue distribution were discussed. It was also suggested that differential tissue distribution may be related to such characteristics as sexual maturation, and a preliminary report on this problem has been made (2).

The present paper is concerned with the relationship of breast development in girls to the growth of fat, muscle and bone in the leg. In broader terms it is thus a study of the relationships between sexual maturation and body structure, as they are reflected by a single maturational criterion and by the tissue distributions in a single body area. Although this report is concerned for the most part with girls between the ages of 7 1/2 and 12 1/2 years of age, certain observations on boys are included.

The children are all regular participants in the Fels Research Institute program, and include 48 girls and 30 boys, on whom a longitudinal series of 417 special sets of "soft-tissue" roentgenograms have been taken. The schedules and techniques for taking the roentgenograms, and the method of measuring tissue breadths from them, are discussed in the previous paper (1).[1]

[1] *"Soft-tissue" roentgenograms of eight representative areas of the body are taken annually on all Fels children, beginning at 6 ½ years. The films are taken at a 6-foot focal-film distance, under standard conditions of positioning. Only the leg area is reported on in this paper. The breadths of fat (plus skin), bone (tibia plus fibula), and muscle mass (including lateral, medial and interosseous) are measured from the roentgenogram, at the position of greatest calf breadth. In the present study, the interosseous space, considered separately in the original paper (1), has been included as a part of muscle breadth. In this way, the breadths of fat, muscle and bone when totalled equal the calf*

Sexual Maturation

It is recognized that no single maturational criterion completely describes the process of maturation. Such criteria as menarche, skeletal development, endocrine status, growth rates, and various measurements and external features associated with maturation have been described in recent studies (3, 4, 5, 6, 7, 8, 9).

Serial observations of sexual maturation are made twice yearly on all Fels children, and are supplemented by inspection of nude photographs taken at that time. All the features mentioned above are recorded (10). One such characteristic is the age at bud-stage of breast development (11, 12), which is determined for each girl. This is a maturational feature which is relatively easy to identify; it appears early in the sequence of somatic changes accompanying pubescence, and shows certain associations with other maturational features.

The mean age at first appearance of breast buds in the 48 Fels girls studied is 10.7 ± 1.1 years, and the coefficient of correlation (r) between this characteristic and time of menarche in 27 girls is .894. The next definitive maturational item available, first appearance of pigmented pubic hair, has a mean of 11.2 ± 1.1 years for these same girls, and the r between this item and menarche is .637. The r between first sign of breast development and first appearance of pubic hair is .601. In 39 of the 48 girls, breast development appeared as soon as (11 cases) or prior to (28 cases) pubic hair.

In boys, the best available item appeared to be time of appearance of pigmented pubic hair, corresponding to item 3 in the listing of external changes associated with male sexual maturation, as described by Greulich, et al. (7). These boys would fall into maturity group 2-3 in their monograph.

Girls who showed breast development by 10 1/2 years of age were classed as "early-maturing," while those who showed no sign of breast development by this age were classed as "late-maturing." There were 24 girls in each category. Boys who showed pigmented pubic hair by 12 1/2 years (17 cases) were classed as "early-maturing," while boys who did not show this feature by this age were classed as "late-maturing" (13 cases). Although there seems good reason to believe that early appearance of these maturational items is related to early sexual maturation as a whole, the descriptive terms used are limited to their definition as given above.

breadth, and the relative breadths of fat, muscle and bone when totalled equal 100 percent.

Distributions of these cases, by maturity group, by age-level, and by number of annual x-rays taken on each child, are shown in Table 1.

TABLE 1

DISTRIBUTION OF CASES

(1) By Number of Annual X-rays per Child

	Boys				Girls		
No.	Early-Maturing	Late-Maturing	Total	No.	Early-Maturing	Late-Maturing	Total
3	0	0	0	3	1	0	1
4	1	1	2	4	5	4	9
5	6	4	10	5	11	9	20
6	9	8	17	6	6	9	15
7	1	0	1	7	1	2	3
	17	13	30		24	24	48

Total Number of Children: 78

(2) By Age

	Boys				Girls		
Age	Early-Maturing	Late-Maturing	Total	Age	Early-Maturing	Late-Maturing	Total
6.5	1	0	1	6.5	9	5	14
7.5	8	4	12	7.5	16	13	29
8.5	8	5	13	8.5	16	16	32
9.5	9	9	18	9.5	20	22	42
10.5	14	11	25	10.5	18	23	41
11.5	16	13	29	11.5	14	18	32
12.5	15	12	27	12.5	11	16	27
13.5	10	8	18	13.5	7	8	15
14.5	7	7	14	14.5	7	6	13
15.5	4	3	7	15.5	3	2	5
16.5	3	0	3	16.5	0	0	0
	95	72	167		121	129	250

Total Number of X-rays: 417

As shown in Table 1, most of the children (66 out of 78) have had five or more consecutive annual x-rays taken. For most comparisons, the period between 7 1/2 and 12 1/2 years will be considered.

Results

Height and Weight

Before considering the relationships of sexual maturation to the breadth of the calf, and to the breadths of fat, muscle and

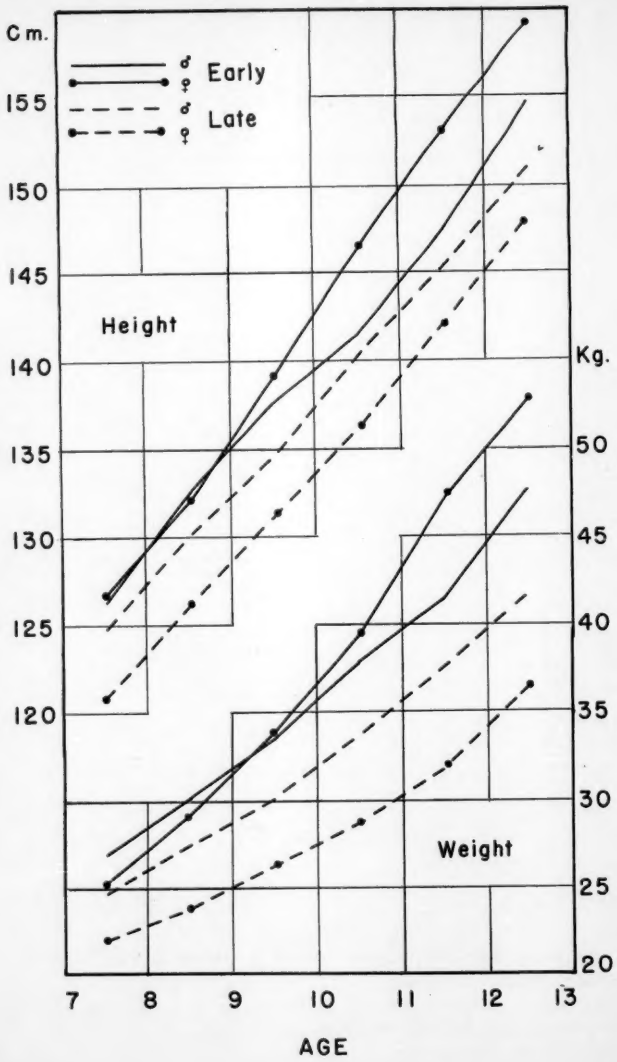

Figure 1. Means of heights and weights for early- and late-maturing girls and boys.

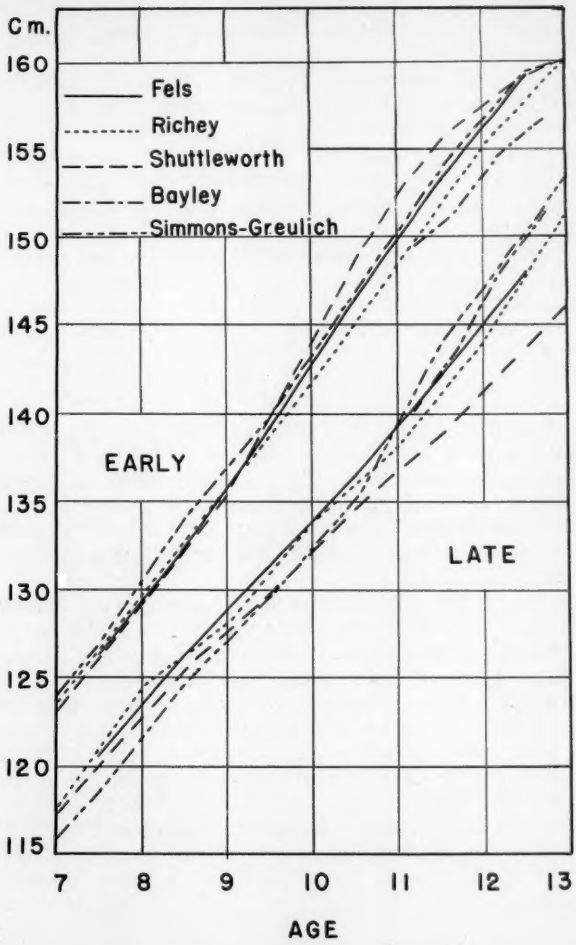

Figure 2. A comparison of mean heights for early- and late-maturing girls, based on five reports: Richey (3), Shuttleworth (6), Bayley (8), Simmons and Greulich (9), and the present study. Because of differences in group norms, all Shuttleworth values have been increased by 4 cm., and all Simmons and Greulich values decreased by 3 cm.

bone within the calf, a comparison was made of height and weight curves, for both early- and late-maturing groups of girls and boys. The results are shown in Figure 1.

In both height and weight, the mean values for early-maturing girls are not only larger than the means for late-maturing girls at every age-level considered, but they are also, after 9 1/2 years, larger than the means for either of the boys' maturity groups. Early-maturing boys are larger on the average than late-maturing boys of the same age, but the difference is much less pronounced than in the girls.

A number of other studies have compared the heights and weights of early- and late-maturing children, using various criteria of sexual maturation. Richey (3) used the time of appearance of axillary hair in boys and of menarche in girls. Shuttleworth (4, 5, 6) employed time of menarche in girls, and age at the close of the year of maximum growth in standing height (MG-age) for both boys and girls. Bayley (8) used skeletal maturation, based on Todd standards (13), in her study of the body build of adolescents. Simmons and Greulich (9) used both menarche and skeletal age in their study of the Brush Foundation series of girls. In Figure 2, the mean heights obtained in the present paper, using time of breast development as a criterion of sexual maturation, are compared with data from these four papers.

In spite of the variety of criteria employed for classifying maturity groups, and the varying number of maturity groups separated out in the several studies, the mean heights within each maturity group show a reasonable correspondence in all five studies. In the Shuttleworth series, the early-maturing girls tend to be taller, and the late-maturing girls shorter, than in the Fels series. This could be expected, since Shuttleworth used a nine-fold maturity classification for girls, and the curves here plotted represent the extremes. Richey, Bayley, and Simmons and Greulich used three-fold classifications.

Similar comparisons for girls' weight, and for height and weight in boys, present much the same picture, and are not shown here.

Norms for Early- and Late-Maturing Girls

Tables 2, 3, 4 and 5 compare early- and late-maturing girls in terms of total breadth of calf, and breadths of fat, muscle and bone within the calf. Means, standard deviations and coefficients of variation are shown. Figure 3 presents the means in graphic form.

The greater mean breadth of the calf in the early-maturing group is apparent at every age-level studied, as shown in Figure

TABLE 2

TOTAL BREADTH OF CALF (mm.)

Early-Maturing Girls

Age	No.	Mean	S. D.	C. V. (%)
7.5 Years	14	82.6	6.4	7.7
8.5 Years	14	87.3	6.3	7.2
9.5 Years	18	91.0	7.6	8.4
10.5 Years	18	97.2	7.3	7.5
11.5 Years	14	103.9	10.2	9.8
12.5 Years	11	109.1	11.0	10.0

Late-Maturing Girls

Age	No.	Mean	S. D.	C. V. (%)
7.5 Years	12	79.3	6.2	7.8
8.5 Years	15	80.9	5.8	7.2
9.5 Years	21	83.3	6.4	7.7
10.5 Years	23	85.9	6.4	7.4
11.5 Years	18	88.8	8.0	9.0
12.5 Years	16	91.2	6.4	7.0

TABLE 3

BREADTH OF FAT (mm.)

Early-Maturing Girls

Age	No.	Mean	S. D.	C. V. (%)
7.5 Years	14	14.5	2.6	18.1
8.5 Years	14	15.0	3.0	20.3
9.5 Years	18	15.6	3.3	21.1
10.5 Years	18	16.0	2.8	17.7
11.5 Years	14	18.1	2.6	14.2
12.5 Years	11	19.2	2.4	12.7

Late-Maturing Girls

Age	No.	Mean	S. D.	C. V. (%)
7.5 Years	12	11.6	3.6	31.5
8.5 Years	15	12.1	3.5	28.9
9.5 Years	21	12.2	3.1	25.5
10.5 Years	23	13.0	3.1	24.2
11.5 Years	18	13.4	4.0	30.1
12.5 Years	16	13.3	3.4	25.2

TABLE 4

BREADTH OF MUSCLE MASS (mm.)

Early-Maturing Girls

Age	No.	Mean	S. D.	C. V. (%)
7.5 Years	14	42.8	6.1	14.2
8.5 Years	14	46.0	5.9	12.8
9.5 Years	18	48.0	6.6	13.7
10.5 Years	18	52.0	5.8	11.1
11.5 Years	14	54.5	7.4	13.5
12.5 Years	11	58.0	8.6	14.9

Late-Maturing Girls

Age	No.	Mean	S. D.	C. V. (%)
7.5 Years	12	43.6	4.3	9.8
8.5 Years	15	44.4	4.0	8.9
9.5 Years	21	45.5	4.5	9.9
10.5 Years	23	46.2	4.4	9.5
11.5 Years	18	47.3	5.1	10.9
12.5 Years	16	49.3	4.9	9.9

TABLE 5

BREADTH OF BONE (mm.)

Early-Maturing Girls

Age	No.	Mean	S. D.	C. V. (%)
7.5 Years	14	25.4	1.3	5.2
8.5 Years	14	26.3	1.4	5.2
9.5 Years	18	27.4	1.5	5.5
10.5 Years	18	29.2	1.9	6.6
11.5 Years	14	31.3	2.0	6.3
12.5 Years	11	32.0	2.0	6.2

Late-Maturing Girls

Age	No.	Mean	S. D.	C. V. (%)
7.5 Years	12	24.1	2.2	9.0
8.5 Years	15	24.4	2.0	8.0
9.5 Years	21	25.6	1.9	7.5
10.5 Years	23	26.7	2.4	9.1
11.5 Years	18	28.1	2.7	9.6
12.5 Years	16	28.6	2.5	8.8

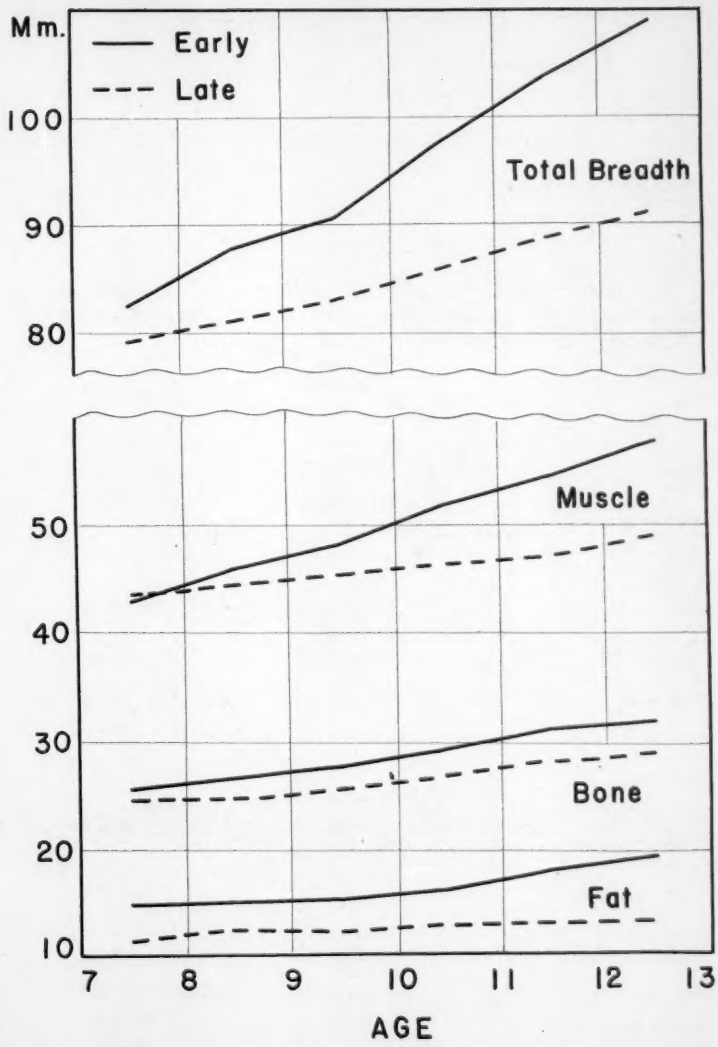

Figure 3. Means of total breadth of calf, and of fat, muscle and bone breadths within the calf, for early- and late-maturing girls.

3; early-maturing girls are on the average about 3 mm. larger at 7 1/2 years, and increase this difference to 18 mm. at 12 1/2 years. In individual tissue breadths, early-maturing girls are larger in every characteristic except mean muscle breadth at 7 1/2 years.

At the 5 percent level of significance, early-maturing girls are significantly larger as follows: total calf breadth, 8 1/2 through 12 1/2 years; breadth of fat, all ages; breadth of muscle, 10 1/2 through 12 1/2; breadth of bone, 8 1/2 through 12 1/2.

Growth Rates

The shifts in differential tissue patterns can be shown more meaningfully by considering growth rates (Table 6), than by comparing absolute values.

TABLE 6

RATES OF INCREASE IN CALF BREADTH AND TISSUE BREADTHS, BETWEEN 7 1/2 AND 12 1/2 YEARS

Early-Maturing Girls

	Total Breadth of Calf	Breadth of Fat	Breadth of Muscle	Breadth of Bone
Mean Value at 12 1/2 Years (mm.)	109.1	19.2	58.0	32.0
Mean Value at 7 1/2 Years (mm.)	82.6	14.5	42.8	25.4
Gain (mm.)	26.5	4.7 (18%)	15.2 (57%)	6.6 (25%)
Rate of Gain (%)	32.1	32.6	35.6	26.0

Late-Maturing Girls

	Total Breadth of Calf	Breadth of Fat	Breadth of Muscle	Breadth of Bone
Mean Value at 12 1/2 Years (mm.)	91.2	13.3	49.3	28.6
Mean Value at 7 1/2 Years (mm.)	79.3	11.6	43.6	24.1
Gain (mm.)	11.9	1.7 (14%)	5.7 (48%)	4.5 (38%)
Rate of Gain (%)	15.0	14.9	13.0	18.7

When rates of increase in size are considered, early-maturing girls show a rate of gain of 32.1 percent in total breadth of calf, for the 5-year period between 7 1/2 and 12 1/2 years.

During this same age-period, late-maturing girls show a rate of gain of only 15.0 percent. These differences also show in the growth rates of the individual tissues within each maturity group. Early-maturing girls have a rate of gain for mean breadth of fat of 32.6 percent, for mean muscle breadth 35.6 percent, and for mean bone breadth 26.0 percent. In late-maturing girls, the rate of gain for mean fat breadth is 14.9 percent, for mean muscle breadth 13.0 percent, and for mean bone breadth 18.7 percent.

Considered in another way (Table 6), early-maturing girls during this period show a mean increase in total breadth of calf of 26.5 mm., of which fat, muscle and bone breadths contribute percentages of 18, 57 and 25, respectively. Late-maturing girls, on the other hand, during this same period, show a total increase of only 11.9 mm., of which fat, muscle and bone breadths contribute percentages of 14, 48 and 38, respectively.

In summary, early-maturing girls are larger in the absolute size of the calf breadth and of the three component tissues, between 7 1/2 and 12 1/2 years of age. They also show a higher rate of gain, both for total calf breadth, and for each of the three tissue breadths. Finally, in the early-maturing group, the growth rate for muscle breadth is higher than for total breadth of calf, while the growth rate for bone breadth is lower. In the late-maturing group, this picture is reversed: the growth rate for muscle breadth is lower than for total breadth of calf, while the growth rate for bone breadth is higher.

TABLE 7

RELATIVE BREADTHS OF FAT, MUSCLE AND BONE, AT 7 1/2 AND 12 1/2 YEARS

7 1/2 Years

	Relative Fat (Percent)	Relative Muscle (Percent)	Relative Bone (Percent)
Group	16.1	53.3	30.6
Early-Maturing Girls	17.6	51.6	30.8
Late-Maturing Girls	14.3	55.2	30.4

12 1/2 Years

	Relative Fat (Percent)	Relative Muscle (Percent)	Relative Bone (Percent)
Group	16.2	53.5	30.3
Early-Maturing Girls	17.4	52.9	29.6
Late-Maturing Girls	14.6	54.1	31.3

Relative Breadths

Norms for the relative breadths of the three tissue components (individual tissue breadths expressed as a percentage of total breadth) have been calculated for early- and late-maturing girls. They will not be presented here in detail, but their pattern is clear, and the results at 7 1/2 and 12 1/2 years are shown in Table 7.

At both age-levels shown in Table 7 (and at all intervening ages as well), early-maturing girls show a relatively greater mean fat breadth, and a relatively smaller mean muscle breadth. There is little difference between the two groups in mean relative bone breadth at 7 1/2 years, but by 12 1/2 years early-maturing girls are relatively smaller. It may be noted that the group norms for the mean relative breadths of the three tissues shift very little between 7 1/2 and 12 1/2 years, remaining close to 16 percent for fat, 53 percent for muscle, and 30 percent for bone.

Coefficients of Variation

Certain differences between early- and late-maturing girls may be shown by an examination of the coefficients of variation in Tables 2-5. Early-maturing girls tend to be slightly more variable in total calf breadth. However, differences are more clearly shown in the values for the individual tissue breadths. Early-maturing girls are more variable in breadth of muscle during this period, and late-maturing girls more variable in breadths of fat and bone. As in the group values discussed in the previous paper (1), breadth of fat is in general the most variable item, and breadth of bone the least.

Correlations

In Table 8, certain relationships between time of breast development and the growth of the calf are examined, by means of the coefficient of correlation.

Zero-order coefficients of correlation show an increasingly close relationship between early breast development and greater breadth of individual tissue components, at succeeding age-levels. The values show the same patterns for fat and bone breadths, increasing from -.27 to -.76 for fat, and from -.34 to -.65 for bone. Muscle breadth shows little relationship to time of breast development at earlier age-levels, but increases to -.63 at 12 1/2 years. The r between time of breast development and total calf breadth shows a steady rise from -.22 to -.81.

The following coefficients show statistical significance at the 5 percent level: time of breast development with total calf

TABLE 8

COEFFICIENTS OF CORRELATION, GIRLS

Zero Order

Item	Age 7 1/2	8 1/2	9 1/2	10 1/2	11 1/2	12 1/2
Time of Breast Development and Total Breadth of Calf	-.22	-.44	-.50	-.64	-.72	-.81
Time of Breast Development and Breadth of Fat	-.27	-.29	-.41	-.46	-.64	-.76
Time of Breast Development and Breadth of Muscle	+.05	-.21	-.25	-.49	-.52	-.63
Time of Breast Development and Breadth of Bone	-.34	-.52	-.50	-.53	-.63	-.65
Breadth of Fat and Breadth of Muscle	-.14	.00	+.21	+.38	+.57	+.59
Breadth of Fat and Breadth of Bone	+.56	+.53	+.48	+.51	+.62	+.55
Breadth of Muscle and Breadth of Bone	-.17	-.03	-.01	+.15	+.31	+.26

Second Order

Item	7 1/2	8 1/2	9 1/2	10 1/2	11 1/2	12 1/2
Time of Breast Development and Breadth of Fat	-.10	-.02	-.16	-.11	-.24	-.44
Time of Breast Development and Breadth of Muscle	-.01	-.26	-.25	-.44	-.30	-.43
Time of Breast Development and Breadth of Bone	-.24	-.47	-.41	-.44	-.42	-.49
Number of Cases	29	32	42	41	32	27

breadth, 8 1/2 through 12 1/2 years; with fat breadth, 9 1/2 through 12 1/2; with muscle breadth, 10 1/2 through 12 1/2; and with bone breadth 8 1/2 through 12 1/2.

When the above values are corrected for the intercorrelations between the three tissue components, the second-order partial coefficients show the same tendency to increase with age. However, the values are in general lower, and the relationships shift somewhat. The partial r between time of breast development and fat breadth remains low until 12 1/2 years, when it becomes significant at -.44. The coefficient for time of

breast development and muscle breadth rises from near zero to the forties, being significant at 10 1/2 and 12 1/2 years. The value for time of breast development and bone breadth remains, after 7 1/2 years, consistently in the forties, and is statistically significant.

The multiple R for time of breast development and the three tissue breadths parallels the zero-order r of time of breast development and total calf breadth, rising from .35 at 7 1/2 to .85 at 12 1/2 years.

A Longitudinal Comparison of Early- and Late-Maturing Girls, Matched for Total Breadth of Calf at 7 1/2 Years

In the preceding sections, comparisons have been made of early- and late-maturing girls by a consideration of values which are partly cross-sectional, partly longitudinal in nature. This is because of the presence of some but not all of the same cases at adjacent age-levels, a "shingle-like" effect which is a common situation in longitudinal studies of human development. In the present section, a strictly longitudinal approach is made, in that the same girls are represented at four successive age-levels. In addition, the two groups are matched for mean size of calf at 7 1/2 years. This was done by ranking the values for total breadth of calf in each maturity group, and successively eliminating the largest early-maturing girls, and the smallest late-maturing girls, until the mean values for the latter group exceeded the former. Ten girls of each group were thus obtained, and their mean values, for all four tissue variables, between the ages of 7 1/2 and 10 1/2 years, are shown in Figure 4.

The ten girls of each maturity group, whose means are compared in Figure 4, thus represent the ten smallest early-maturing girls and the ten largest late-maturing girls, in size of calf at 7 1/2 years. As can be seen, the matching of the two groups in mean calf size reflects only the larger muscle breadths, at this age-level, of the late-maturing girls. In spite of being smaller in mean calf breadth, the early-maturing group is larger in mean fat and bone breadths, and maintains this size superiority through 10 1/2 years. In muscle breadth, the early-maturing girls overcome the early size handicap, and by 10 1/2 years are also larger than late-maturing girls in this characteristic, and of course in total breadth of calf as well.

An additional small series of five cases in each maturity group was treated in the same manner at 10 1/2 years, and followed through 12 1/2 years. The results may also be seen in Figure 4. Much the same pattern is shown, except that fat breadth in the early-maturing group is slightly smaller at 10 1/2 years, and remains smaller during the next two years.

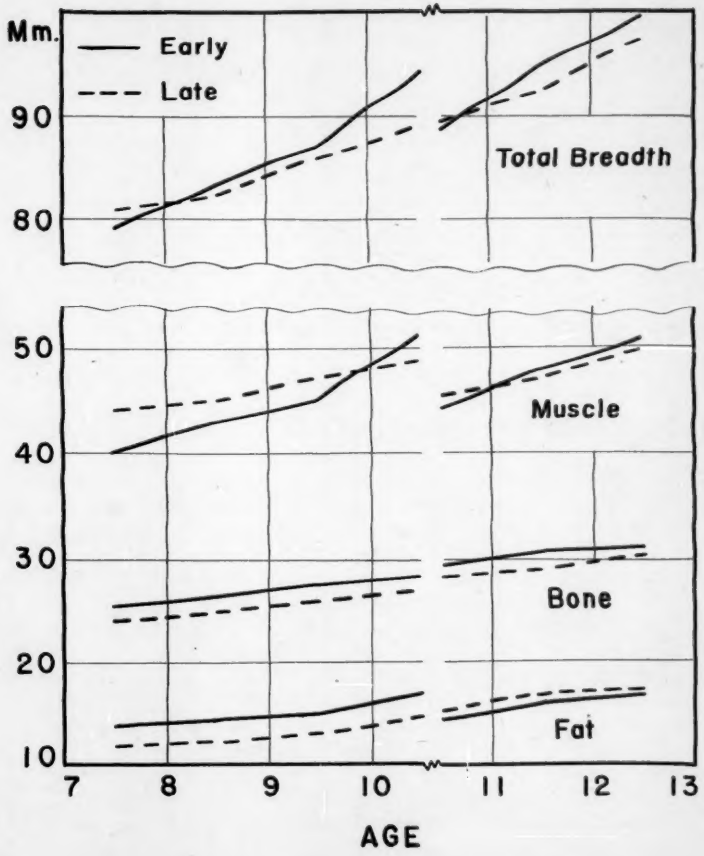

Figure 4. A comparison of mean tissue breadths for early- and late-maturing girls, based on the selection of the ten smallest early-maturing girls at 7 1/2 years, and the ten largest late-maturing girls at the same age. These two groups are followed through 10 1/2 years, when another selection of 6 girls in each maturity group is made, and followed through 12 1/2 years.

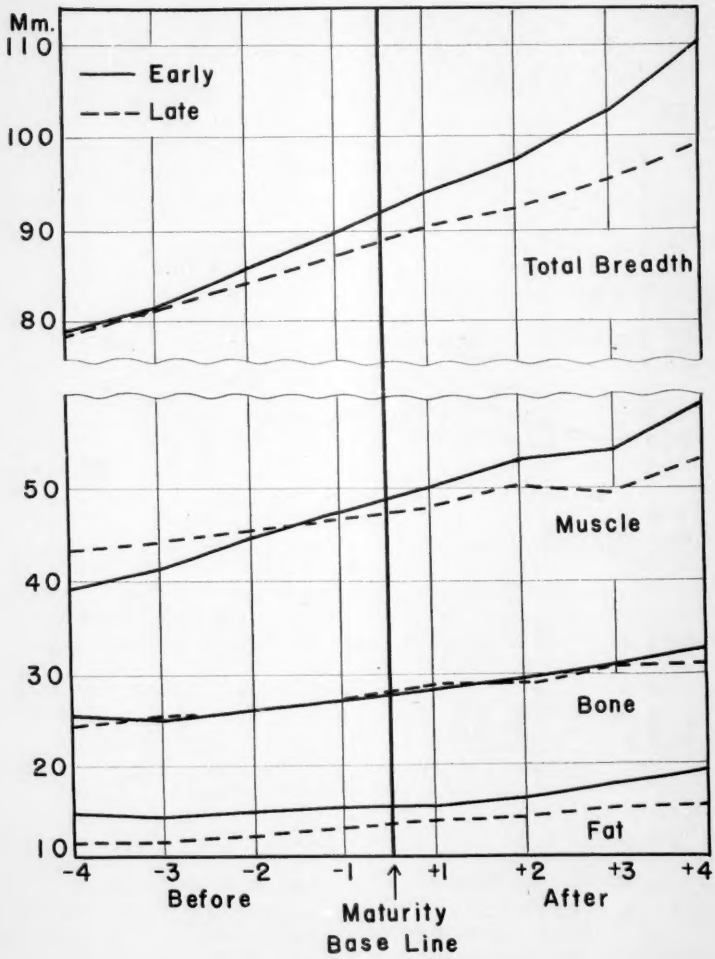

Figure 5. A comparison of mean tissue breadths for early- and late-maturing girls, arranged so that individual ages at first appearance of breast-buds fall on the maturity base-line. See text.

A Comparison of Early- and Late-Maturing Girls, using Time of Breast Development as a Base-Line

In Figure 5, early- and late-maturing girls are compared by a method which in part relates patterns of tissue growth to sexual maturation, rather than to chronological age.

The captions "before" and "after" in Figure 5 refer to the sequence of annual x-rays, taken each half-birthday, as related to each girl's age at first appearance of breast development. Thus, if a girl's maturity age is 11 years, -1 refers to her individual tissue breadths at 10 1/2 years, while -2 refers to her measurements at 9 1/2 years, and so on. In like manner, +1 refers to her measurements at 11 1/2 years, +2 to her measurements at 12 1/2 years, and so on. In this way, patterns of tissue breadths are equated to time of breast development, and the mean values for all girls at the same chronological distance from individual times of breast development are compared.

There is practically no difference between the two maturity groups in mean total breadth of calf, for the -4 and the -3 measuring periods. That is, early-maturing girls, at 3 1/2 years and at 2 1/2 years before age at first breast development, are no larger on the average than late-maturing girls at comparable periods. However, beginning at about 1 1/2 years before time of breast development (-2 period), and continuing through the maturity base-line and four measuring periods beyond, early-maturing girls progressively widen the size difference between themselves and late-maturing girls.

This simple pattern of a gradually widening difference between the larger early-maturing girls and the smaller late-maturing girls corresponds to the familiar picture shown by weight and height, and by over-all, external measurements of body size. However, when the patterns for fat, muscle and bone breadths are compared by the same method, each tissue component appears to behave in a distinctive fashion. With time of breast development held constant, the two maturity groups cannot be clearly distinguished by mean breadth of bone. In mean breadth of fat, early-maturing girls remain consistently larger, both before and after time of breast development. In mean breadth of muscle, early-maturing girls are distinctly smaller before time of breast development, but increase much more rapidly, passing the late-maturing group near the -1 period, and continue their rapid progress to become distinctly larger by the +4 period.

The gradually widening differences in total calf breadth between early- and late-maturing girls appears, therefore, to be a resultant of three quite different patterns of growth in the breadths of the fat, muscle and bone within the calf.

Early- and Late-Maturing Boys

Problems of considerable interest and importance lie in the study of sex-differences in growth during the period of sexual maturation. These problems go beyond the size differences which are associated directly with earlier sexual maturation in girls. In terms of the present study, such questions as these arise: When sexual maturation is equated for the sexes, what general sex differences exist in the growth patterns for fat, muscle and bone breadths? How do the differences in tissue patterns between early- and late-maturing boys compare with the differences in tissue patterns between early- and late-maturing girls?

Sufficient data have not been collected to attempt to answer such questions. However, certain observations on boys are presented in this section, based on the small number of cases (17 early-maturing and 13 late-maturing boys) so far available.

Comparisons of early- and late-maturing boys by height and weight have already been discussed. Early-maturing boys are larger than late-maturing boys in both mean height and mean weight, at each age-level studied, but the differences are less pronounced than in the girls.

Early-maturing boys are larger than late-maturing boys in mean breadths of the calf, and of fat, muscle and bone within the calf, at each age-level between 9 1/2 and 12 1/2 years. The differences, however, are not as great as in the girls. Also, the mean relative fat breadths for early-maturing boys are larger, and the mean relative breadths for muscle and bone are smaller, than in late-maturing boys; a similar comparison holds for the girls.

The growth rate for total breadth of calf in early-maturing boys, between the ages of 9 1/2 and 12 1/2, is 14 percent; in late-maturing boys the rate is 15 percent. This is quite different from the comparison of early- and late-maturing girls during the same age-period: early-maturing girls gain 18 percent during these three years, and late-maturing girls only 8 percent. Other sex differences show in the comparison of the rates for individual tissues. Early-maturing boys gain 19.5 mm. in total calf breadth during these three years. Of this gain, fat, muscle and bone breadths contribute percentages of 8, 54 and 38, respectively. Late-maturing boys, during this same period, gain 20.6 mm., of which fat, muscle and bone breadths contribute percentages of 22, 48 and 30, respectively. The main differential in boys, therefore, appears to be the faster rate of growth in fat breadth in late-maturing boys. These comparisons refer, of course, only to the period between 9 1/2 and 12 1/2 years.

When early- and late-maturing boys are matched for size of calf at 10 1/2 years, and a subsequent longitudinal comparison made, the differences which characterized the girls' groups appear at a somewhat later age. The chief difference between early- and late-maturing boys, between 10 1/2 and 13 1/2, lies in the greater fat breadth of early-maturing boys. Between 13 1/2 and 15 1/2, the rapidly increasing breadth of muscle, together with the consistently greater breadth of fat and bone, distinguishes the early-maturing group.

When early- and late-maturing boys are compared by using time of first appearance of pigmented pubic hair as a maturity base-line, the differences observed in the girls' groups are not fully apparent until the +3 period. Breadth of fat, however, is consistently larger in early-maturing boys at every period.

In summary, early-maturing boys are larger than late-maturing boys in total breadth of calf, and in the breadths of the three component tissues, at every age-level between 9 1/2 and 12 1/2 years. They show relatively greater fat breadths, and relatively smaller muscle and bone breadths. They do not show the faster rate of growth which is characteristic of early-maturing girls during this chronological period. When matched for size of calf at 10 1/2 years, and then followed longitudinally, early-maturing boys show the pattern (already described for the girls) of a rapidly increasing breadth of muscle, together with a consistently greater breadth of fat and bone, although less well defined, and at a considerably later age-level. When equated for time of appearance of pigmented pubic hair, the distinctive individual patterns of tissue breadths already described for the girls tend to appear also for the boys, but at a later time. In breadth of fat, however, early-maturing boys (as is the case in the girls) are consistently larger than late-maturing boys.

Discussion

A major purpose of the present paper has been to test whether simple measurements of tissue breadths in one anatomic area are sufficiently sensitive to be used as tools in the study of human growth. For this purpose, sexual maturation was chosen as a process known to be associated with rapid increase in body size, and the differential patterns of fat, muscle and bone breadths in the calf were studied in relation to this feature. Sexual maturation was defined in terms of breast development, since that is a characteristic which is easy to identify, and appears early and regularly in the sequence of somatic changes accompanying pubescence.

Such an investigation, based on measurements taken in a single anatomic area, and considering a process identified by a single criterion, is necessarily exploratory. Even at this preliminary stage, however, certain statements seem justified. First, external dimensions and total body weight give no reliable indications of the distribution of tissue components within the body. As demonstrated in a previous paper, two children may be matched for age, sex, height, weight, external calf dimensions and tibia length, and yet show clear-cut differences in the distribution of fat, muscle and bone within the calf.

Second, from the above it follows that a growth curve based on external dimensions or total mass, although it offers valuable information for other purposes, does not show the changing relationships of its tissue components. In this connection, Weinbach (14) says:

> "The growth of man, as a multi-cellular organism, is the sum of the growth of all the individual cells or groups of cells (tissues) of which the organism is composed. Considering the human body to be made up of tissues which obey one or the other of the two preceding types of growth, i.e., self-accelerating growth or self-inhibiting growth . . . X-ray studies of the growth of muscle and fat on the forearm indicate that the fat follows closely the decelerating law of growth, while the muscle is of the accelerating type." (pp. 236, 244.)

The fact that the various tissues have their individual patterns of growth has been discussed and illustrated in a number of studies, notably in the well-known work of Scammon, as reported in Harris, et al. (15). More recently, Jacoby (16) has studied changes in area as seen in cross-sections of cadaver material, while Wilmer (17) has reported on distribution by weight of several body components in fetal life, at birth, and in maturity. Stuart, et al. (18) has written several papers based on linear and areal examination of x-ray material.

Third, it must be emphasized that the breadth measurements discussed in this paper are concerned with only one dimension of the tissue masses as seen in the x-ray, and must be interpreted in this way. These measurements are closely related to tissue mass, but do not completely describe changes in structure, any more than an increase in total height need necessarily involve a change in total weight. Tissue breadths are one way of describing body structure, and are subject to the limitations of any linear measurements of bulk. Their particular value lies in the fact that they make possible certain comparisons of

body structure not available from external measurements or weight.

Fourth, it is obvious that an increase of a millimeter in bone breadth is not equivalent to an increase of a millimeter in fat breadth, either as it affects body weight or volume, or in terms of biochemical and physiological relations within the organism. For this same reason, however, a child who shows an increase of a millimeter in bone breadth is a different kind of child from one who shows an increase of a millimeter in fat breadth. A child who shows tissue breadths of 11, 59 and 30 percentages for fat, muscle and bone is a different kind of child from one who shows values of 24, 42 and 34 percentages for these three components, even though their external dimensions may be similar. Therefore, although the exact meaning of such differences may not yet be clear, nor the explanation for differential tissue development fully understood, the demonstration of such differences in tissue growth appears to be justified.

Fifth, the biochemistry program now under way at the Fels Institute gives great promise of providing measures which will make individual differences in tissue distribution much more meaningful. The program at present includes an intensive study of nutritional status, endocrine function and tissue metabolism, as approached through measurements of vitamin excretion levels, vitamin load tests, serum proteins, ketosteriod and estrogen elaboration and excretion, creatine-creatinine metabolism, and blood enzyme levels (19). The relationship of differential tissue growth to fundamental metabolic processes, as determined by such biochemical measures, will be examined in subsequent reports.

SUMMARY AND CONCLUSIONS

This paper is concerned with the problem of the relationship of sexual maturation in girls to the growth of individual tissue components in the body. As an approach to this problem, a report is here given of the relationship of one aspect of sexual maturation (time of breast development) to the changing patterns of the distribution of fat, muscle and bone breadths in one anatomical area (the leg).

Certain observations on boys, using the appearance of pigmented pubic hair as a maturity criterion, are also included.

The children in this study, 48 girls and 30 boys between the ages of 6 1/2 and 16 1/2 years, are regular participants in the Fels Research Institute program. The data on sexual maturation are obtained from semi-annual examinations and from nude photographs taken at this time. The data on body structure

are obtained from records of height and weight, and from 417 serial roentgenograms, taken specifically for the study of tissue differentiation.

The conclusions may be summarized as follows:

1. Early-maturing girls are larger than late-maturing girls in mean height and weight, at every age-level between 7 1/2 and 12 1/2 years. After 9 1/2 years, they are also larger than the means for either of the boys' maturity groups. These results are compared with the reports from four other investigations of the relationship of weight and height to sexual maturation.

2. Early-maturing girls are larger than late-maturing girls in total breadth of calf, and in the breadths of fat, muscle and bone within the calf, at every age-level studied. The significance of these differences is presented. The differences in boys are in the same direction, but to a lesser degree.

3. Early-maturing girls show a distinctly higher rate of gain in total breadth of calf, and in the breadths of the three tissue components, than do late-maturing girls. Boys do not show this difference in rates, during the age-range studied.

4. Early-maturing girls show a growth rate for muscle breadth which is higher than for total breadth of calf, and a growth rate for bone breadth which is lower. In late-maturing girls, the growth rate for muscle breadth is lower than for total breadth of calf, while the growth rate for bone breadth is higher.

5. Early-maturing girls, during this period, show a greater mean relative breadth of fat, and a smaller mean relative breadth of muscle and of bone, than do late-maturing girls. The same pattern holds for boys.

6. Early-maturing girls tend to be more variable in total calf breadth, and in muscle breadth, and less variable in breadths of fat and of bone, than do late-maturing girls.

7. Coefficients of correlation indicate an increasingly close relationship between early breast development and greater breadths of individual tissue components, at succeeding age-levels between 7 1/2 and 12 1/2 years. In addition to this general pattern, coefficients relating time of breast development to each of the three tissue components, when corrected for intercorrelations between the components, show certain individual patterns of relationship.

8. Results are given of a longitudinal comparison of early- and late-maturing girls, matched for mean size of calf at 7 1/2 years. Differential patterns of tissue distribution are discussed. Results of a similar comparison for boys are presented.

9. Results are given of a comparison of early- and late-

maturing girls, with patterns of tissue growth corrected for individual differences in sexual maturity. The simple pattern of a gradually widening difference in total calf breadth between early- and late-maturing girls, when observed in this fashion, appears to be a resultant of three quite different patterns of growth in the breadths of fat, muscle and bone within the calf. Results of a similar comparison for boys are presented.

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THE SPEECH BEHAVIOUR OF INFANTS WITHOUT FAMILIES

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The research on infant speech has until recently been mainly concerned with technical problems of measurement and with the establishment of normative sequences of speech development for the young child. As a clinical instrument these norms look extremely promising; they offer standardizations obtained from a large number of cases on the basis of which one may measure deviations in a manner similar to that used in intelligence testing (1).

Interest in this research area has gradually been shifting, however, in another direction. While these norms undoubtedly will offer a basis on which one may objectively determine the speech status of any individual child with respect to the sampled population, they tell us little by themselves about the relevant variables which have contributed to the status. Nor do they, therefore, tell us anything about the possibility or desirability of changing a specific individual's status. If such variables could be isolated we might achieve theoretical knowledge, as well as a diagnostic measure, of language acquisition during the earliest stages of the life history and its relation to the later acquisition of more complex symbolic habits.

If we started with children who diverged markedly from the speech norms established by recent investigators, it is quite possible that common causal factors in their environment contributing to the deviations could be discovered. If such factors could be found, they might be varied in a reasonably controlled situation, so as to experimentally weight their differential influence. Such a program would be costly and tedious to realize, however, and probably would have to be done through amorphous clinical channels. If, on the other hand, we could find homogeneous populations which differed as a group with the norms established thus far, research would not be so technically encumbered. We have a technique that meets these requirements in what the anthropologists call "cross-cultural comparisons."

Now, one of the basic criteria used by the anthropologists to distinguish cultures is the structure of the family group, broadly conceived. It is predominantly within this institution, under the guidance of parents as cultural surrogates, that the individual learns a complex set of responses which carry over into interactions with more formally organized institutions. Any difference in the character of the family structure and/or its cultural

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surrogates would presumably affect the learning process itself, through both the administration and types of rewards and punishments used. This, in turn, would influence the character of the manifest cultural responses.

It is obvious that speech sounds function both as social responses and as social stimuli. The unpatterned speech of the infant is frequently a response to the behaviour of the members of the family, and in turn its speech sounds stimulate them to respond with culturally determined rewards and punishments. It is in these combined ways that infant speech acquires cultural meaning. When, as in this study, we compare orphanage infants with family infant groups, it is obvious that there are present wide differences with respect to family organization, cultural surrogates, and consequently the learning process itself. The presence of these conditions permits us to view our study on infant speech behaviour as a quasi-anthropological type of research.

Since this is the first systematic work, as far as we know, on the speech behaviour of orphanage infants at so early an age, its rather introductory nature should be emphasized. It is, of course, a general observation that children who grow up in the ordinary orphanage home are somewhat retarded in their speech development. Our study opens up the problem during the very earliest months of the orphanage child.

Procedure

The orphanage subjects of this study were 94 infants whose ages ranged from birth to six months of age. These subjects were residents of the Iowa Soldiers Home at Davenport, Iowa. They were divided into three age groups - from birth to two months, two to four months, and four to six months of age. There were 35 subjects in the first group, 33 in the second, and 26 in the third group. The subjects were classified as "dependent or neglected" children, the criterion of which is either 1) being destitute, homeless or abandoned or otherwise dependent on the public for support or 2) living in unfit surroundings, of either a physical or moral character or both. Feeble-minded children are not accepted at the Davenport orphanage and are transferred by the Iowa State Board of Control if so diagnosed.

The speech sound measurements of these orphanage children were then compared with measurements obtained from family infants living in Iowa City, grouped in the same way according to age, and containing 62, 80 and 75 babies in the successive age level periods.

A competent nurse of long experience in the institution was in charge of the babies and a physician is attached to the staff.

The day-to-day work of caring for the infants is done by hired, non-professional, female workers who are drawn mainly from the lower socio-economic level of the community. There is a large turnover among these employees. In addition, these women are usually assisted by several older orphanage girls. Thus, the bulk of the personnel, with the exception of the nurse and physician, are of quite elementary education, trained to carry on the simpler techniques of caring for the babies and not at all motivated by strong personal interest or responsibility.

In regard to the handling of the infants, all of them are bottle-fed and all receive satisfactory care so far as their physical needs are concerned. Excellent medical attention is provided. There is, however, little personal attention in the way of being held, played with or spoken to, except incidentally and sporadically.

The actual recording of sounds followed a definite procedure. While the infants lay asleep in their bassinets the observer recorded the name, sex, birth date, and recording date on a card, which was then left in the crib. When an infant awoke and began to vocalize, the observer stood beside the crib and took records until vocalization ceased. This was done in turn with each child in the nursery. Sometimes more than one infant would vocalize simultaneously. In this situation, a sample of breaths of one infant was completed before a sample of the other was taken. Thus, no conflict of observation arose, which might distort the results.

The unit of measurement was a behaviour rather than a time unit. The type and number of sounds were recorded for twenty or more discrete breaths for each subject and were taken only on the exhalation phase of breathing. The sounds were recorded in terms of the International Phonetic Alphabet as described by Fairbanks (2). The breath as a unit of measurement is advantageous because its length is easily within the attention span of the observer, thus permitting higher reliabilities between research workers. The International Phonetic Alphabet permits standardization of the qualitative aspects (the content) of the sounds.

No direct measure of observer reliability could be calculated since the data were collected by a single observer. This reliability has been reported elsewhere (5). In each of these studies the reliabilities reported have been of such a consistently satisfactory nature as to permit us to assume an equally satisfactory reliability for the purposes of the present study.

The reliability of the data was determined by the split-half method. Odd and even sounds as they came constituted the two halves of the data. The formula used has been described else-

where (6). The mean percent of agreement for each differential condition is 90. The range is 66 to 100 for crying sounds. The range for non-crying sounds is 71 to 100.

The distribution of percentages of agreement is presented in the following tabulation.

	CRYING	NON-CRYING
91-100	33	26
81- 90	9	8
71- 80	8	8
61- 70	2	0

Half of the reliabilities for the non-crying data, and over half of the reliabilities for the crying data, fall in the upper interval, 91-100. It is therefore quite evident that there exists a very satisfactory degree of internal consistency in the data.

The Results[1]

The data were analyzed both with regard to frequency, the number of sounds a given child made on all recorded breaths without discounting for any reduplication of sound content, and with regard to type, the number of sounds a given child made on all recorded breaths with any repetition of a given sound discarded. The frequency measure merely indicates the degree or amount of vocalization, whereas the type measure indicates the breadth and richness of vocalized sounds.

Type and frequency measures were calculated for both orphanage and family groups at each successive age level period according to the following conditions:

1. An over-all analysis, combining both crying and non-crying data and consonant and vowel data.
2. An analysis of non-crying data separately, combining both consonant and vowel sounds.

The non-crying data were then broken down into:

1. A comparison of mean vowel and consonant types for both experimental and control groups at the three different age levels.
2. A comparison of mean vowel and consonant frequencies for both groups at the three different age levels.

The results of these analyses are shown in Figures 1 and 2.

[1]*For the detailed statistical treatment of these data see the original thesis in the library of the State University of Iowa: Brodbeck, Arthur J. The phonetic status of orphanage infants: The first half year. Unpublished Master's thesis, State University of Iowa, 1946.*

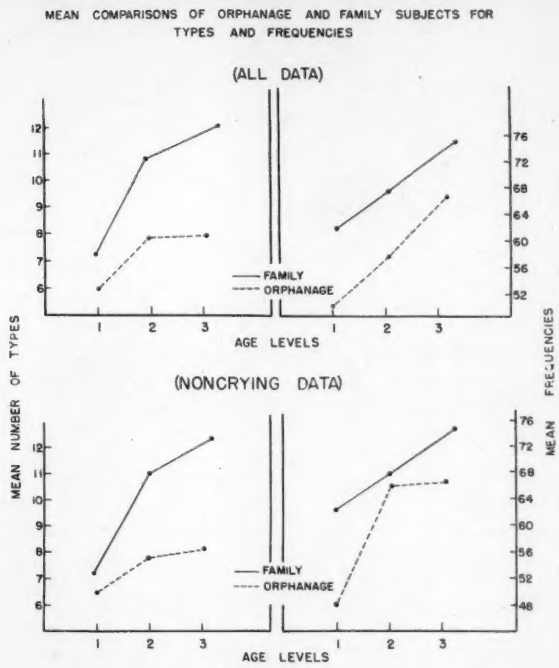

FIGURE 1

An examination of the graphs reveals some similarities. All of the graphs show that the means for orphanage infants fall below the means for family infants at all age levels and for both all type and all frequency measures. Regardless of the reliabilities of the differences, there is little doubt as to the consistency of this finding.

Moreover, the shape of the curves for the two groups is dissimilar. Wherever the speech sound growth curve for orphanage babies reaches a plateau between the second and third age levels, the curve for family infants shows some increment. The former curves flatten out in almost two-thirds of the comparisons, and especially for all analyses of type differences, both with consonant and vowel sounds combined and analyzed separately. There appears, then, to be a differential growth pattern for the two populations.

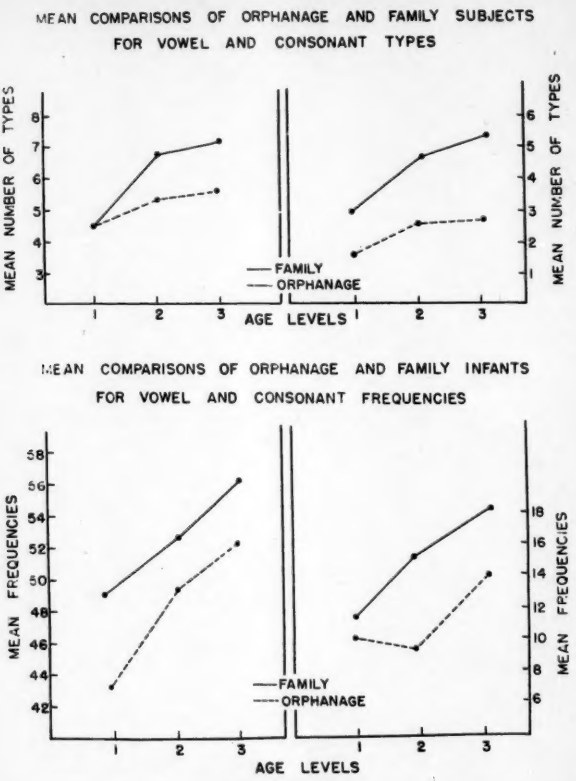

FIGURE 2

TABLE 1

FREQUENCY AND PERCENTAGE DISTRIBUTION OF CRITICAL RATIOS

C.R.	Level of Confidence	Frequency		Type	
		No.	Percent	No.	Percent
2.58+	(1%)	1	8	7	58
2.33+	(2%)	0	0	0	0
1.96+	(5%)	0	0	3	25
1.64+	(10%)	2	17	0	0
below 10%		9	75	2	17

Table 1 shows the frequency and percentage distribution of critical ratios for the mean differences between the two groups for both the type and frequency measures shown in Figures 1 and 2. If we take the 1 percent level of confidence as acceptable (which is equivalent to a critical ratio of 2.58), then more than half (58 percent) of the type differences prove to be significant, while only one (8 percent) of the frequency measures falls above this value.[2] Consonant type differences between the two groups were reliable at all three age levels, and type differences for the crying data, with consonant and vowel sounds combined, became progressively more reliable with increase of infant's age, with a critical ratio of 3.72 obtained at the third age level period.

Having made these analyses, it was still possible that the differences found between the two groups with regard to speech behaviour might be due to a selective socio-economic factor, operative in the placement of infants in the orphanage. We know, in general, that the lower socio-economic groups tend to be somewhat retarded in language development when compared

[2] *It is somewhat difficult to interpret the fact that, while both all type and all frequency mean differences favored the family group, only the type differences proved to be consistently reliable. However, it is to be remembered that the unit of measurement was a behaviour unit, so set up as to arbitrarily exclude extremes of vocalization frequency. That is, records were taken only on breaths during which the infant was making some sound and excluded breaths on which no sound was made. On the other hand, the average breath of an infant may not be long enough to permit reliable discrimination between two individuals or groups. Thus, it is conceivable that one infant may vocalize 400 times a day, while another might vocalize only 200 times a day and, yet, both individuals might vocalize to the maximum on a single breath. The breath unit might in this manner set an arbitrary high and low ceiling above which no reliable discrimination is possible.*

These speculations lead us to believe that a time unit of measurement, under approximately similar stimulating conditions, might increase the range of variability so as to lead to reliable differences between the two populations with respect to frequency of vocalization. A possible unit might be the time elapsing a half hour before feeding to the moment of the actual presentation of the breast or bottle.

Some confirmation for our hypothesis is the fact that, with the exception of consonant frequencies, the most reliable frequency differences were at the earliest age level where we would expect the range of variability to be smallest, and the least reliable were at the later age levels where we would expect the range of variability to be greatest.

with higher-status groups. The family infant data were, therefore, broken down into a professional and unskilled group and the same measures were calculated for each of these subsidiary groups as they had been for the family infant group as a whole previously. The mean results are shown in Table 2.

TABLE 2

COMPARISON OF ORPHANAGE DATA WITH FAMILY DATA OF DIFFERENT SOCIO-ECONOMIC LEVELS

(Non-crying Data)

Periods	1	2	3
	Types		
Professional	7.4	10.7	12.7
Unskilled	7.6	10.9	13.3
Orphanage	6.4	7.7	8.0
	Frequencies		
Professional	60.1	62.2	71.2
Unskilled	60.3	70.6	62.2
Orphanage	48.1	66.1	66.8

An inspection of these means makes it quite evident that there are no very large differences between the two socio-economic groups, and that these small differences tend to favor the lower socio-economic group, especially for those type measures which proved most reliable in the original orphanage and family group comparisons. Furthermore, for all measures of type, the orphanage means deviated from the means of both family groups several times more than did either of the two occupational groups deviate from each other. The deviation of the orphanage means also becomes appreciably greater with age, but the socio-economic deviations do not. The means of the frequency measures did not show any similar consistent trend. It would, therefore, seem to follow that the reliable differences which have been found between orphanage and family infants cannot be solely attributed, if at all, to a selection of orphanage babies from the lower socio-economic strata of the community. Yet the fact that at later ages speech sounds do actually reflect the differences between socio-economic groups, found by other

widely-used tests of language development, is more or less manifested in the results of an unpublished study made by one of the authors, which shows that the curves for the higher socio-economic groups begin to exceed that of the lower group at about one year of life.

Discussion

In her recent book, Infants Without Families, Anna Freud (3) puts forward the observation, based upon clinical work at the Hampstead Nursery, that children under one year of age separated from their parents use speech sounds "as extensively and not less than other children." This result, which of course was not based on any systematic unit of measurement comparable to our frequency and type measures, is explained by the children's drive to gain oral-erotic pleasure during the first year of life and is said to be all the more active, the more the child is left to itself. Dr. Freud does find differences between infants with and without families during the second year of life with regard to the use of patterned speech (words). Such differences disadvantageous for orphanage infants are explained as due to an absence of some form of imitation resulting from the lack of identification or relationship with a mother. In other words, the identification mechanism is not assumed to have differential effects on speech behaviour during the first year of life, and becomes crucial only during the second year when the child begins to use patterned speech.

There is no reason to doubt the precision of Dr. Freud's observations. On the basis of our own results and those of several other investigators, however, there does appear to be some reason to doubt the generality of her theoretical explanations. A recent study by William Goldfarb (4) showed that this deficiency with regard to speech sounds, as well as to other uses of language, continues right up to the third year of life among institutional children, and even after a period of foster home replacement. If the use of speech sounds per se was a function solely of a universal oral drive as Freud hypothesizes, why should these differences continue until the preschool ages, as Goldfarb demonstrated, when the child has already passed through the oral stage of development? Here, again, Dr. Freud underestimates the permanent and primary effects which the early mother-infant relationship exerts, and indeed predicts that the speech differences due to absence of the mother in the second year will be cancelled at the preschool ages, a prediction in flat contradiction to Goldfarb's findings.

Goldfarb, as well as others, has suggested that, through transient and impersonal attendance and in the absence of a

fixed, loving adult, the infant even before the first year cannot readily identify with any of the cultural surrogates around him, and is not motivated to do so, thus remaining retarded in all those functions which depend on social forms of imitation and communication. Presumably, the activity of babbling is at least in part one of these functions, as Lewis (7) and Miller and Dollard (8) have tried to demonstrate. If this hypothesis should be true, then on the basis of our data, the "identification" mechanism may be crucial even during the first six months of life. Dr. Goldfarb specifically states:

> "As early as six months and possibly even somewhat before, one observes the beginnings of sentiments, particularized attitudes, and attachments to a particular person or limited number of people within the primary family circle. Placement observation of babies separated from the parent person at this age indicates that the children experience psychological shock which sometimes may even be prolonged in nature. Nor is the shock ameliorated, for instance, by the simple satisfaction of hunger. A psychological relation between child and specific adult must be reconstituted before the baby's habitual expression of complacency is again observed. Close attachment to specific adults considerably before the end of the first year thus appears to be a fact." (p. 18)

It may very well be that the Hampstead Nurseries are not truly representative of the conditions that regularly exist in most orphanage institutions in the United States. And, as a matter of fact, some of our orphanage babies were well above the means for family infants. We believe that such individual cases (which were exceedingly rare) may be explained by the fact that a worker occasionally develops a fondness for a particular child and would, as a consequence, be more inclined to speak to it and encourage it to answer, as well as to give it more frequent all around stimulation. There is evidence that the social environment of the Hampstead Nursery was more uniformly of such a character. At least this seems a more reasonable hypothesis than Dr. Freud's toward explaining both the results obtained by Goldfarb and ourselves. It is in line, too, with the general clinical results reported by Margaret Ribble (9, 10) although she uses the same psychoanalytic principle of oral-eroticism to explain directly contradictory results to those found by Dr. Freud. Ribble seems to imply that, given a strong oral drive (measured in other than vocalization units) plus the absence of a fixed, affectionate adult, non-crying vocal-

ization (babbling) will be proportionately diminished. It may be, of course, that the two explanations (oral-eroticism vs. communication and imitation) are not incompatible and that only a multiple set of hypotheses can adequately explain the empirical findings regarding early speech behaviour. Until the oral-erotic principle is applied less ambiguously however, it is difficult to assign its relative weight at any stage of development.

Apparently what is needed now by way of rigorous investigation is some kind of clinical survey of the life histories of individual orphanage children who scored extremely low and extremely high when compared with the means of infants living in their own homes. By this method we may be able to isolate the more concrete cultural factors within the orphanage that have made for the manifest differences in speech behaviour. Secondly, there is the possibility of taking a more direct experimental approach through subjecting these children to types of treatment differing from that which they would ordinarily receive under orphanage conditions and measuring the resulting speech behaviour at the conclusion of the experimental treatment. This last procedure would be the more difficult of the two, in so far as it is rather trying to quantify all the factors that might go into such experimental treatments, but it would be more gratifying from the point of view of assessing the relative quantitative importance of a set of independent and manipulatable variables. At any rate, until some work like this is done, all our theoretical explanations remain somewhat academic.

SUMMARY

A group of orphanage infants ranging from one day to six months of age was compared with family infants of the same age range, with respect to various measures of speech behaviour. It was found that:

1. A graphical comparison showed that the orphanage means fell below those of the family means at all age levels and for both type and frequency measures.
2. More than half (58 percent) of the type differences proved to be reliable, but only one (8 percent) of the frequency measures was satisfactory.
3. Consonant type differences were reliable at all age levels, and type differences for the crying data, with vowel and consonant sounds combined, became progressively reliable with increase of age.
4. When the family infant data were broken down into professional and unskilled family groups and again compared with orphanage infants, the orphanage means were found to deviate

from the means of both family groups several times more than did either of the two socio-economic groups deviate from each other, especially for those measures which showed reliable differences between the orphanage and family groups as a whole previously. This finding more or less ruled out the possibility of attributing the previous results solely to a selection of the orphanage infants from lower social status groups.

5. Some exception was taken to the use of the identification mechanism and of the oral-erotic principle by Anna Freud in explaining age differences in infant speech behaviour.

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